TRYGON PWR. SUP.

MODEL CR36-100

SYSTRON DONNER

INSTRUCTION MANUAL

MODEL CR36-100

Copyright © 1975 Systron-Donner Corporation

SYSTRON DONNER CORPORATION

CONCORD INSTRUMENT DIVISION
10 Systron Drive • Concord, California 94518 • U.S.A.
Tel: (415) 676-5000 • TWX: 910-481-9479 • Cable: SYSTRONDONNER
FSCM No. 52542

Printed in U.S.A.

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_06066

-- TABLE OF CONTENTS

SECTION		Page
1	Description	
	1.1 Introduction	1-1
	1.2 General Features	1-1
	1.3 Precautionary Measures	1-2
	SPECIFICATIONS	
2	Installation and Operation	
	2.1 Mechanical Installation	2-1
	2.2 Input, Power	2-1
	2.3 Output, Rear Panel	2-2
	2.4 Controls	2-3
	2.5 Operation	2-4
	2.6 Automatic Load Share Paralleling	2-4
3	Theory of Operation	
	3.1 Positive Auxiliary Supply	3-1
	3.2 Negative Auxiliary Supply	3-1
	3.3 Voltage Reference	3-1
	3.4 Power Circuitry	3-1
	3.5 Phase Sequencing Detector	3-2
	3.6 Missing Phase Detector	3-2
	3.7 Gating Circuitry	3-2
	3.8 Constant Current Bleed	3-3
	3.9 Current Mode Indicator	3-3
	3.10 Voltage Comparator	3-3
	3.11 Current Comparator	3-4
4	Maintenance	
	4.1 General	4-1
	4.2 Loads and Connections	4-1
	4.3 Troubleshooting	4-1
5	Calibration	
	5.1 General	5-1
	5.2 Test Equipment Required	5-1
	5.3 Calibration Procedure	5-1

LIST OF TABLES

TABLE		Page
2-1	AC Input Wire Size	2-2
2-2	Shorting Link Application	2-3
2-3	Front Panel Controls	2-3
4-1	Reference Supply	4-2
4-2	Primary Voltages	4-2
4-3	Voltage Comparator Voltages	4-2

LIST OF ILLUSTRATIONS

2-1	Rear Terminal Strip TB2	2-2
2-2	Automatic Load Share Paralleling	2-5
3-1	Simplified Schematic Voltage Comparator	3-5
3-2	Simplified Schematic Current Comparator	3-6

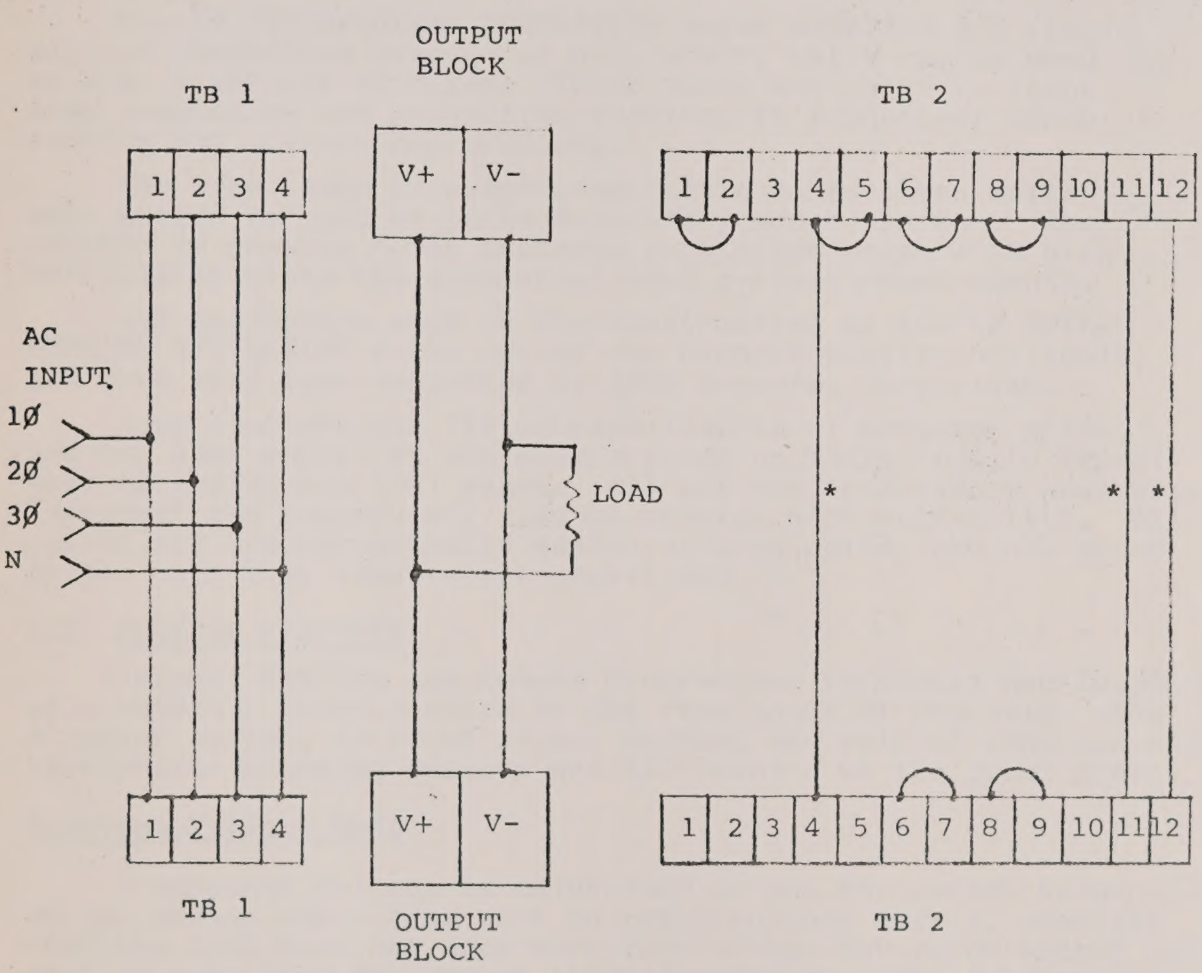
APPENDIX

Parts List
Component Boards
Schematic Diagram

CR Series

AUTO-PARALLEL LOAD-SHARE HOOK-UP

MASTER UNIT



SLAVE UNIT

* Use #18-AWG or larger wire size

Fig. i

3/9/71

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

The CR INTERMEDIATE REGULATION power supplies are flexible and dependable sources of D.C. power, which can be used to meet a variety of needs. These needs may range in scope from inspection and production testing, to laboratory bench testing and systems applications.

The wide range of outputs available makes these units well suited for use as basic laboratory power sources. The ability to provide power packaged in minimum space with high reliability meets the demands of most systems requirements.

All components used in the construction of the CR INTERMEDIATE REGULATION units are of the highest quality available, and have have been subjected to 100% incoming inspection.

Each electrolytic filter capacitor is of computer grade, and has been quoted by the manufacturer as having a life expectancy exceeding ten (10) years. All silicon transistors have been "derated" and temperature aged to provide high reliability. All rectifiers are hermetically sealed silicon units, and all zener diodes have been temperature stabilized.

1.2 GENERAL FEATURES

Output, Sensing and Remote Programming terminals are located on a terminal board mounted on the rear panel of the unit. The AC power switch, AC pilot lamps, current and voltage controls and appropriate metering devices are all located on the front panel.

Constant Voltage Mode

A constant voltage is maintained across the output terminals at any preset value from zero to rated voltage output, provided that the load does not draw more than either the rated output current or more than the preset limiting current value determined by the front panel current control settings.

Constant Current Mode

Constant current operation is achieved by maintaining a constant voltage across an internal current sensing resistor. An automatic crossover network changes the mode of operation from Constant Voltage to Constant Current when the current demand reaches that of the preset current adjust control. The point at which the operating mode automatically changes is a function of variations in load conditions. The crossover point is adjustable, and can be established anywhere within the current and voltage range of the unit.

Automatic Current Limiting

Short circuit protection is provided by the Automatic Current Limiting circuit which limits the maximum output current under all load conditions. The point at which automatic current limiting occurs is variable, and may be selected anywhere between 5% of the rated current output and maximum rated current output of the unit. In the event of a short circuit, the output voltage will drop to zero, and will return to its previous level only upon removal of the short circuit.

Automatic Overvoltage Protection (Optional Feature)

Automatic Overvoltage (OV) protection prevents the output voltage from exceeding approximately 10% or 1.5 volts above the programmed voltage. An internal sensitivity control is provided to desensitize the overvoltage protection circuit.

Remote Programming

Remote Programming is provided in the voltage mode of operation, and may be utilized over the entire voltage range of the unit. The scale factor for Remote Voltage Programming is 100 ohms per volt.

1.3 PRECAUTIONARY MEASURES

Wire Size

To assure proper regulation under all load conditions, and to prevent severe distortions of the AC line voltage, it is very important to take into consideration the physical size and current handling capabilities of the input power line. Serious losses in regulation and an increase in ripple may result from underrated or overloaded AC input lines. The maximum AC impedance from the breaker box to the power supply input should not exceed 0.2 ohms.

Voltage Regulator and Inverter Inputs

Do not use voltage regulators or inverters as a primary power source. The outputs of these devices are usually not sinusoidal in nature, and if used as the AC source for the power supply, will cause serious loss of ragulation of the power supply output.

Systems Considerations

In systems applications it is recommended that each power supply input power line be run separately to the AC distribution box, in order to minimize cross coupling and interaction between equipment. Do not run sensitize signal leads such as the remote sensing leads in the same cable as the AC input without shielding. To keep the AC ripple in the output to a minimum, it is recommended that the AC input cables should not be run in close proximity to the output load cables.

Terminal Post Resistance

All terminals and shorting links serving Outputs, Sensing and Programming must be securely tightened before use. Serious loss of regulation and an increase in ripple can result due to a voltage drop caused by loose terminals and shorting links.

SECTION 2

INSTALLATION AND OPERATION

2.1 MECHANICAL INSTALLATION

2.1.1 Rack Mounting

Any standard EIA relay rack will accommodate the Trygon Intermediate Regulation Series power supplies in only 12 1/4 inches of vertical mounting space. Mounting of the unit is easily accomplished by inserting eight mounting screws through the slotted holes provided in the front panel of the power supply, and on into the matching threaded holes of the relay rack.

2.1.2 Bench Use

Though designed primarily as a rack mounting unit, the Intermediate Regulation Series power supply may be operated in a bench type configuration as well. It is therefore fully enclosed in a protective metal case.

2.2 INPUT, POWER

Standard "CR" supplies require a 3Ø, 4 wire input of 208 volts ±10% line-to-line. When delivering maximum rated power, the supply will draw approximately 20 amperes per phase. Input power connections are made via the four terminal Jones strip (TB1) located on the rear of the supply. Note that the terminal marking A, B, and C are arbitrary phase markings; and that any sequence of line connections will work satisfactory.

Caution: TERMINAL "N" is to be connected to the power line neutral only.

The power handling ability of the AC power lines must be considered, as serious losses in regulation and substantial increases in ripple can occur as a result of insufficient power handling capacity of these lines. The AC impedance from the breaker box to the power supply input connector should not exceed 0.2 ohms. All AC power line connections must be securely tightened, and any movable electric contact surface (such as the wiper arm of a variable transformer) should be kept clear of impedance producing oxide coatings.

Care should be exercised in selecting the proper wire size for the AC input lines. The figures listed in Table 2-1 will serve as a guide in making this selection.

TABLE 2-1 AC INPUT WIRE SIZE	
Length of Run (Single Lead)	Wire Size (AWG Standards
10 feet or less	10
10 feet to 20 feet	8
20 feet to 50 feet	6
50 feet to 100 feet	4

2.3 OUTPUT, REAR PANEL

A twelve terminal barrier strip (TB2) mounted on the rear panel provides sensing, programming, ground connections and provisions for paralleling. BARRIER STRIP terminal connections marked -V and +V have been provided as convenience TERMINALS only and ARE NOT TO BE USED FOR THE PURPOSE OF CONNECTING THE UNIT TO THE LOAD.

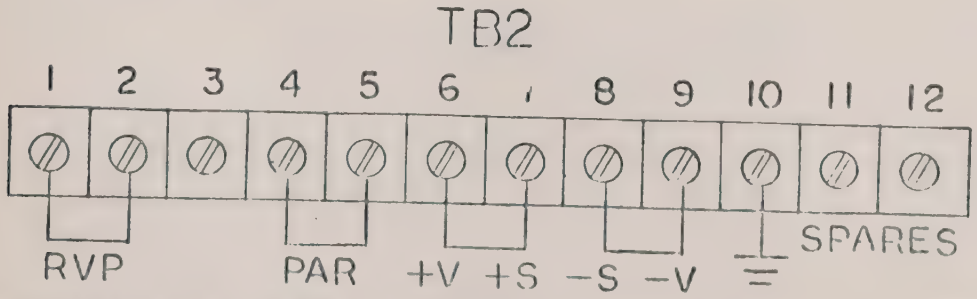
Shorting Link Application, Rear Panel

The power supply is shipped from the factory with shorting links in place across terminals 1 and 2, 4 and 5, 6 and 7, and 8 and 9 of the rear panel barrier strip. In this configuration, and with the load connected across the rear panel output terminals, local sensing and programming operation from the rear panel is provided.

Additional operating configurations may easily be achieved by changing shorting link connections or adding external wiring and controls, as outlined in TABLE 2-2 SHORTING LINK APPLICATION, REAR PANEL. Any one of the four combinations of functions may be used in conjunction with the CONSTANT VOLTAGE mode of operation.

FIGURE 2-1 REAR TERMINAL STRIP TB-2

Shorting Links



* Terminals 11 and 12 are used for remote current programming, only if this option incorporated. A shorting link is required across terminals 11 and 12 only if this option is incorporated but is not being utilized.

TABLE 2-2 SHORTING LINK APPLICATION, REAR PANEL		
SELECTION	FUNCTION	CONNECTIONS REQUIRED
1	Local Sensing Local Programming	1 and 2; 6 and 7 8 and 9; 4 and 5
2	Local Sensing Remote Programming	4 and 5; 8 and 9 6 and 7; PGM resistor across 1 and 2
3	Remote Sensing Local Programming	4 and 5 * 6 connected at load (+) 8 connected at load (-) 1 and 2
4	Remote Sensing Remote Programming	4 and 5 * 6 connected at load (+) 8 connected at load (-) 2 and 3; PGM resistor across 1 and 2

NOTE: The shorting link between terminals 4 and 5 must be connected for all modes of operation, except when AUTO-PARALLELING IDENTICAL SUPPLIES.

* The load must be connected to the terminals on TB3.

2.4 CONTROLS

Front Panel

TABLE 2-3 FRONT PANEL CONTROLS	
Name	Function
AC POWER	3Ø CIRCUIT BREAKER (CB1), controls input power
VOLTAGE ADJUST (Vernier)	Potentiometer, adjusts voltage output
VOLTAGE ADJUST (Coarse)	Potentiometer, adjusts voltage output
CURRENT ADJUST	Potentiometer, adjusts current

Internal

All internal control settings have been factory preset, and require no additional adjusting. However, if it should become necessary to adjust any of the internal controls due to circuit changes caused by component aging or replacement, refer to the calibration section of this instruction manual.

2.5 OPERATION

Control Settings

Set all front panel controls fully CW so that unit will operate in the Voltage rather than Current Limiting mode.

Shorting Links

If Local Sensing rather than Remote Sensing operation is desired, ascertain that shorting links are in place across the appropriate terminals.

Grounding

Either side of the Output may be grounded, or the Output may be used in a floating condition.

Power On

Connect the power supply to a nominal 3Ø 60 Hz. power source. Set circuit breaker CB1 to AC-ON, and observe that pilot lamps glow.

Warm-Up

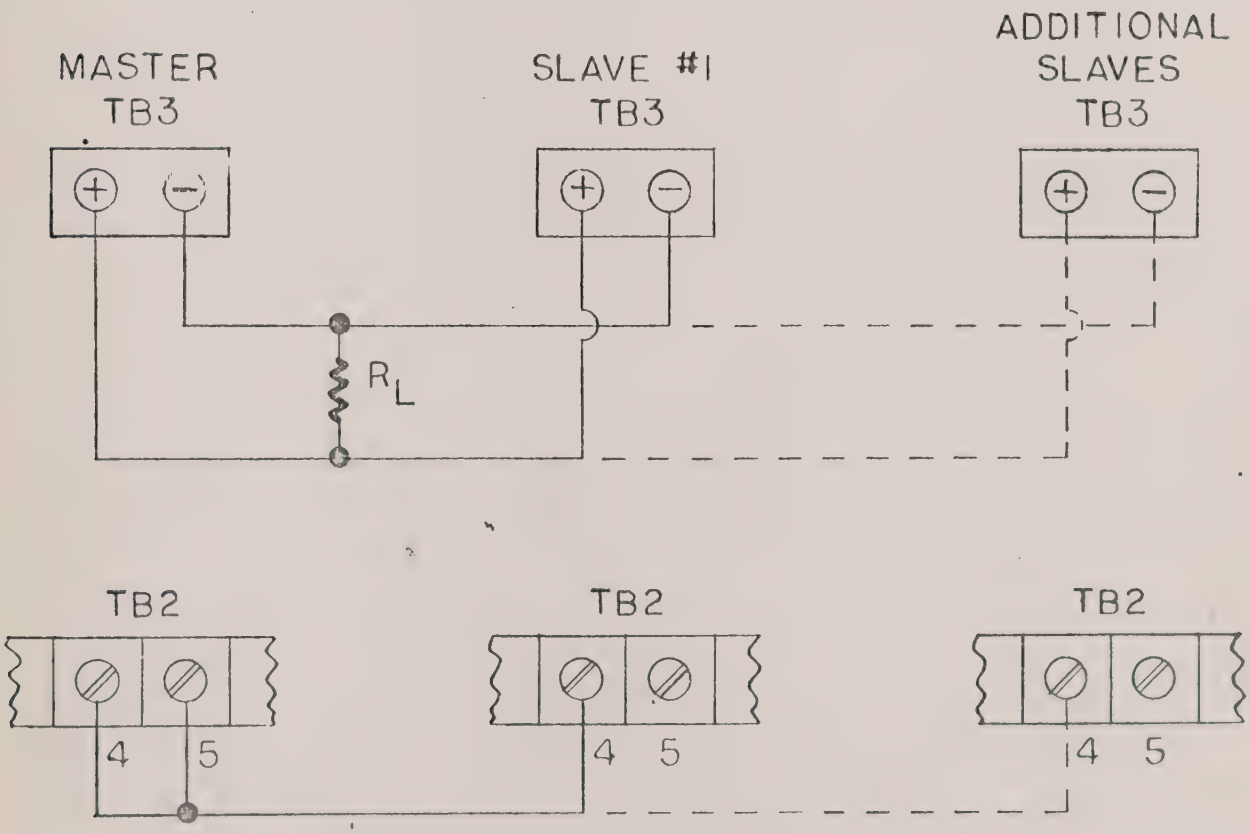
No warm-up time is necessary to place the unit into operation. However, a 30 minute warm-up period is recommended to reach rated stability.

2.6 AUTOMATIC LOAD SHARE PARALLELING (SEE ADDENDUM)

Set the front panel current limiting adjustment on each supply to its maximum setting and the "Master" voltage controls to the desired voltage.

Apply rated load and adjust the load sharing controls (R27) on the rear of each unit to achieve equal current contribution from each supply.

FIGURE 2-2 AUTOMATIC LOAD SHARE PARALLELING



NOTE: If parallel operation of CR INTERMEDIATE REGULATION power supplies utilizing Overvoltage Protection (O.V.) is desired, consult the factory for special instructions.

SECTION 3

THEORY OF OPERATION

3.1 POSITIVE AUXILIARY SUPPLY

The Positive Auxiliary Supply provides an unregulated DC voltage of low ripple content to feed the power supply reference and forward bias the zener diode (CR29) in the constant current bleed circuit. Approximately 32 volts will be established across C6 at nominal input voltage. This voltage is obtained via 3 phase full wave rectification from the secondaries of transformers T2, T3 and T4. The following diodes are utilized in developing the 32 volt potential across C6: CR65, CR60, CR59, CR54, CR53 and CR48.

3.2 NEGATIVE AUXILIARY SUPPLY

The Negative Auxiliary Supply provides an unregulated DC voltage of low ripple content to feed zener diode CR11 in the constant current reference supply. Approximately 32 volts will be established across C22 at nominal input voltage. This voltage is obtained via 3 phase full wave rectification from the same transformers used to develop the positive auxiliary voltage. The following diodes are used to develop this voltage: CR64, CR61, CR58, CR55, CR52 and CR49.

3.3 VOLTAGE REFERENCE

The Voltage Reference develops a highly stable precision DC output of 15 volts, used to bias and supply voltage to the critical differential amplifiers. It must be emphasized that any ripple component, noise or lack of stability present on the output of the voltage reference will be amplified by the differential voltage comparator Q1 and Q2 and will be present to a larger degree at the power supply terminals.

The voltage reference is supplied from the positive auxiliary supply thru R33 and is clamped by zener diode CR11 at 24 volts. Zener diode CR10, a 5.1 volt zener diode establishes a 18.9 volts on the base of Q8 relative to the anode of CR11. THE ANODE OF CR11 OR THE "+S" SENSING TERMINAL, AN ELECTRICALLY IDENTICAL POINT, WILL BE USED AS A REFERENCE OR ZERO POINT FOR ALL VOLTAGE MEASUREMENTS, UNLESS OTHERWISE STATED. The emitter of Q8 will be .8 volts higher than its base placing 4.3 volts across R30. Q8 function as a current generator supplying 15 ma.

3.4 POWER CIRCUITRY

All CR Intermediate Regulation Series power supplies are designed for operation from a three phase power line and employ a three phase power transformer T1; the output of this transformer is fed into a three phase full wave bridge, consisting of three rectifiers, CR23, CR24 and CR25 and three silicon control rectifiers, CR20, CR21 and CR22. Output voltage control is obtained by delaying the firing angle of these SCR's to meet the demands placed on the supply.

The output of this bridge is fed into an iron core inductor, L1, and capacitors C13 thru C17 for filtering.

3.5 PHASE SEQUENCING DETECTOR

The Phase Sequencing Detector permits all CR Series power supplies to be connected to the appropriate 3 phase power line without the need to determine the direction of phase rotation prior to making power line connections. The phase detector consists of a special unbalanced 3 phase load; R64, R65 and C18. The voltage developed across R65 is fed into a full wave bridge (CR32, CR33, CR34 and CR35) and rectified output is used to control the coil on relay K1. If the power line phase sequence was such that proper operation of the supply would exist with relay K1 in the de-energized state, relay K1 would have only 6 volts on its 24 volt coil. However if the phase were incorrect, 24 volts would be applied to the coil of K1 causing it to energize and its contact switching would automatically correct the phase sequencing of the SCR gate signals.

3.6 MISSING PHASE DETECTORS

In the event one phase of the input power line is lost the "Missing Phase Detector" will shut down the power supply. This condition may confi[illegible] by observing that one or more of the front panel lamps are not illuminated. Operation of the missing phase detector follow: The secondary of each auxiliary transformer will produce a DC voltage across a separate capacitor, only when voltage on the phase feeding that particular transformer is present. Diodes CR62 and CR63 will charge up C21; diodes CR57 and CR56 will charge up C20 and diodes CR51 and CR50 will charge up C19. When 3 phase line voltage is present, these capacitors, C19, C20 and C21 will be charged up to about 28 volts, reverse biasing the "Missing Phase Gate Diodes" CR45, CR46 and CR47. Under these conditions transistor Q20 will conduct, since base current is provided from the positive auxiliary voltage, thru R88, CR28 and R75. If one phase of the input power line were lost, [illegible] the base of zener diode CR28 such that transistor Q19 from supplying pulses to the silicon control rectifiers.

3.7 GATING CIRCUITRY

The Gating Circuitry provides to each silicon control rectifier a pulse of the proper amplitude and timing to allow the power supply to meet the output demands made upon it.

The emitter of unijunction transistor Q19 is fed from the collector of Q7 and will produce a pulse across the base 1 resistor, R68, when ever additional input voltage is required. This pulse is amplified by transistors Q20 and Q22, providing a pulse of approximately 20 volts amplitude on the collectors of Q22, Q16, Q17 and Q18. The pulse is distributed to the base of the SCR by transistors Q16, Q17 and Q18, dependent on the bias on their respective bases. The base of each of these transistors are fed these resistors connects to two diodes. These diodes function as OR gates. For example, transistor Q16 will distribute the pulse feed to its collector, to an SCR only when OR gate diodes CR41 and CR42 are both reversed biased.

The cathode of the OR gate diodes CR39 thru CR44 each connect to a different transformer lead which provides the proper signal for each respective gate. The anodes of each OR gate connect via a fixed resistor, an adjustable resistor and a diode to the base of transistor R74. These variable resistors, R78, R81 and R86 are adjusted to provide a balanced ripple output (viewed on an oscilloscope) when the supply is delivering approximately 15% of rated output voltage at full rated current. The voltage applied to the base Q74, a rectangular type wave form of high duty cycle, will turn transistor Q24 on and off at a rate of 180 Hz or three times power line frequency. Q24 supplies the drive for Q23, turning it on and off at the same rate. The voltage developed on the collector of Q23 is fed thru resistor R71 where it is clamped by a 5.1 volt zener CR27. This voltage, a rectangular wave form of very high duty cycle, is fed to base 2 of the unijunction transistor. It is this wave form that synchronizes the unijunction transistor to the power line frequency.

3.8 CONSTANT CURRENT BLEED

The Constant Current Bleed permits the output DC voltage to be rapidly reduced by providing a load to discharge the input capacitors C13 thru C17. The bleed is made up of three power transistors (Q13, Q14 and Q15) in parallel, with Q12 used as a driver. Zener diode CR29 is forward biased by 8 volts via the positive auxiliary voltage and R59. The voltage on the base of the driver Q12 with reference to the negative output voltage is clamped to 1.5 volts by series combination of diodes CR17, CR18 and CR19. At high output voltages, the voltage developed across R52, R56 and R57 due to the current flowing thru R53, R54 and R55 respectively will produce a voltage sufficient to reverse bias and cut off all four transistors. As the output voltage is decreased these transistors will began to conduct and the total current drawn will remain approximately 10% of the rated current of the power supply.

3.9 CURRENT MODE INDICATOR

The Current Mode Indicator circuit is responsible for illuminating the front panel current mode light whenever the power supply is functioning in the constant current mode of operation.

The circuit consists of four transistors, Q3, Q4, Q5 and Q6. The mode indicator lamp is connected between a 24 volt source and the collector of Q5. Q4 and Q5 form a differential amplifier used to improve the sharpness of transition from the "on" to "off" state. Transistors Q4 and Q5 are driven by transistors Q3 and Q6 respectively. The base of Q6 connects to the anode of "OR" gate diode CR7 and also senses the collector current drawn by Q10, the current differential. Likewise, transistor Q5 connects to the anode of "OR" gate diode CR6, and also senses the current drawn by transistor Q1 of the voltage differential.

3.10 VOLTAGE COMPARATOR

The Voltage Comparator is a differential amplifier that "compares" a portion of the output voltage to a calibrated voltage and produce an error signal used to correct for any unbalance in these voltages.

This error signal is fed to the base of transistor Q7 via "OR" gate diode CR6 only when the supply is functioning in the constant voltage mode.

The operation of the voltage comparator is as follows, (refer to Fig. 3-1);

The base of transistor Q2 is at 7.5 volts due to the voltage divider consisting of R17 and R18. In the voltage mode, the voltage comparator is a balanced differential therefore, the voltage on the base of Q1 is also 7.5 volts. Since the base current of the differential is very small, 7.5 volts is placed across the series combination of R1 and R2. This voltage will force a constant current of approximately 10 ma to flow through the series combination of R1, R2, R3, R4, R49 and R50. Resistors R3 and R4 are selected to provide zero output when R49 and R50 are set to minimum resistance. The output voltage range is determined by R49 and R50 and is approximately 1 volt for every 100Ω's of resistance. The collector of Q1 is connected to the base of Q7 via "OR" gate diode CR6. CR6 will be forward biased whenever the power supply is functioning in the constant voltage mode of operation.

3.11 CURRENT COMPARATOR

The Current Comparator is a differential amplifier that "compares" a voltage proportional to the output current with a calibrated voltage and produces an error signal used to correct for any difference in these voltage levels. This error signal is fed to the base of transistor Q7 via "OR" gate diode CR7 only when the supply is functioning in the constant current mode.

The operation of the current comparator is as follows, (refer to Fig. 3-2);

The "+V" Sensing Terminal will be used as a reference or zero point for all voltage measurements unless otherwise stated.

The base of transistor Q10 is connected via R36 to the "+V" output terminal. Since the base current of transistor Q10 is very small (10-50 ma), the voltage drop across R36 is negligible, and the base is at zero potential. Resistors R34 and R35 and zener diodes CR12 and CR13 form a cascade zener diode voltage regulator resulting in a 5.1 volt potential across capacitor C7.

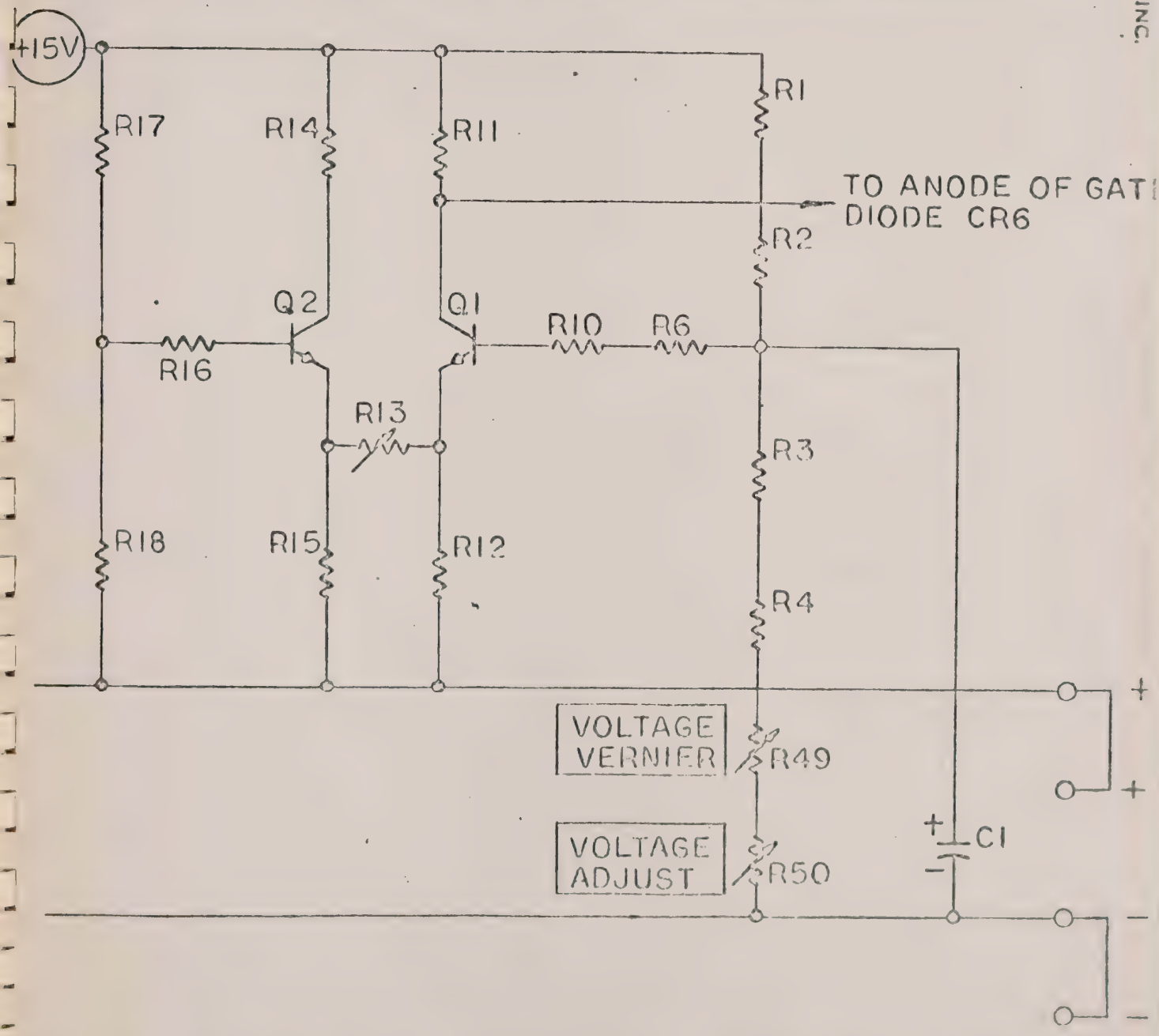
The emitter of transistor Q10 will be about .7 volts negative due to the base to emitter drop. The resulting voltage across the parallel combination of R38 and R40 will demand approximately 1.8 ma from the 15 volt source.

The base of transistor Q11 is connected via resistors R43 and R46 to a tap on a voltage divide consisting of the front panel current adjustment control R60 on one side of the divide and the internal maximum current adjustment R48 in series with R47 on the other side of the divide.

R48 is adjusted to provide a maximum output current of 110% of rated current when the front panel current adjustment control is set for maximum current. One end of the current adjustment control, R60 is common to one end of the current sensing resistor R51, and as a result a voltage proportional to the load current is applied to R60.

Whenever the power supply is operating in the constant current mode transistor Q11 will forward biased causing the collector voltage on Q10 to rise. This rise in voltage is fed via "OR" gate diode CR7 to the base of Q7.

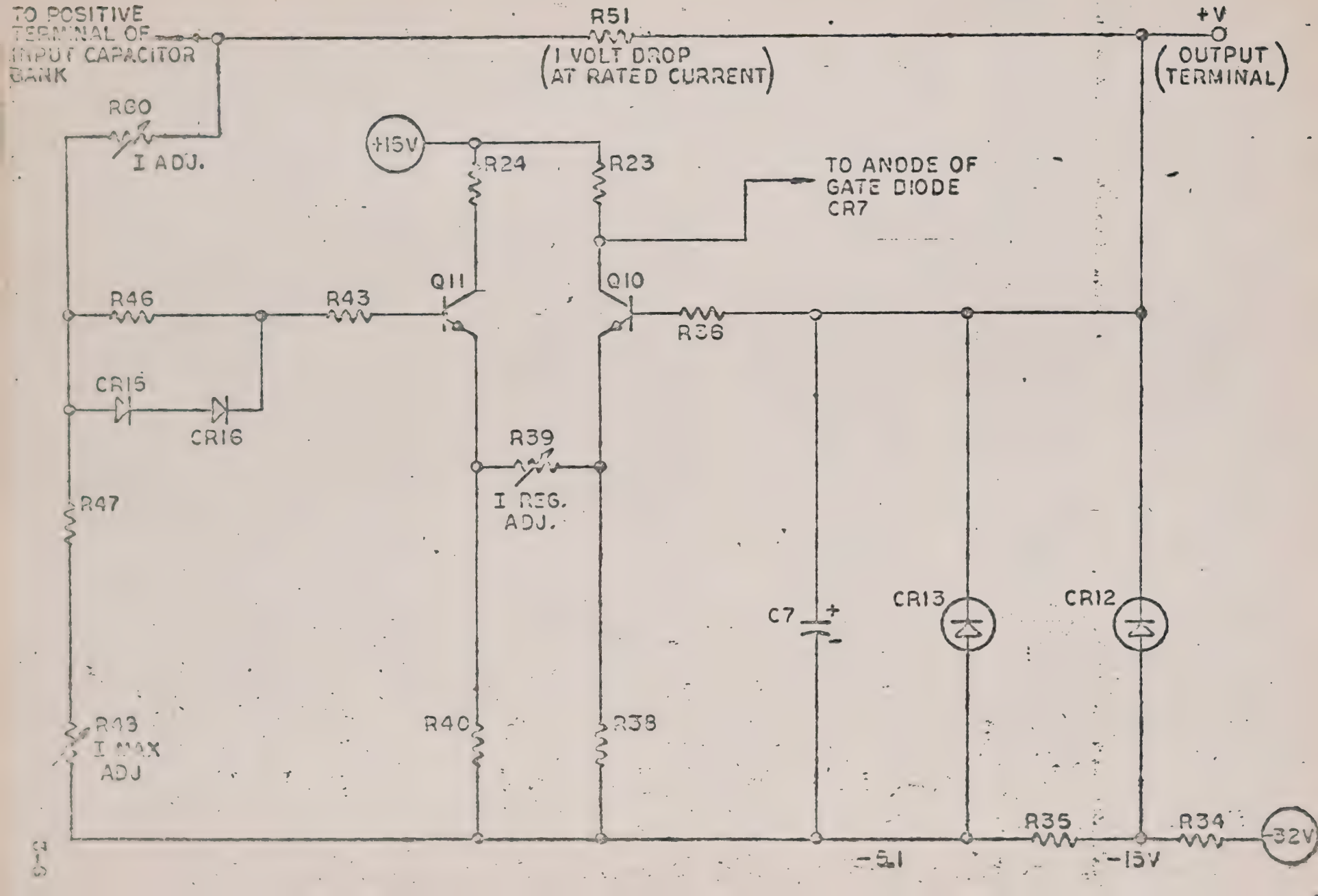
FIGURE 3-1 *SIMPLIFIED SCHEMATIC- THE VOLTAGE COMPARATOR



*IN THE INTEREST OF CLARITY SOME COMPONENTS HAVE NOT BEEN SHOWN.

FIG. 3-2

SIMPLIFIED SCHEMATIC – THE CURRENT COMPARATOR



SECTION 4

MAINTENANCE

4.1 GENERAL

This power supply is a precision instrument. It is strongly recommended that only experienced troubleshooting personnel perform troubleshooting operations or attempt to repair the unit. If the power supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1) Disconnect all loads and interconnections.

2) Connect a resistive load across the output terminals, and operate the unit to determine whether the fault lies within the unit or externally. Observe that Shorting Links are in place across terminals 1 and 2, 4 and 5, 6 and 7, and 8 and 9, and that all connections are tightly made.

4.3 TROUBLESHOOTING

1) Set VOLTAGE ADJUST control R49 and VOLTAGE VERNIER control R50 fully CW. Use a 20,000Ω's per volt voltmeter or oscilliscope to check the voltages across the various circuit components listed in the Troubleshooting tables of this section. Any reading which is grossly incorrect indicates that the stage being tested or the one preceding it, is defective. The Block Diagram, Schematic Diagram, Component Board Drawings and appropriate sections of the Theory of Operation will prove very helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily obtained from the Schematic Diagram.

2) If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point to point resistance checks across pots, switches, diodes, resistors, transistors in that order.

3) When the trouble is of an intermittent nature such as poor regulation, ripple etc., the use of an oscilloscope to determine dynamic changes will be necessary. The section on Theory of Operation should be consulted to determine circuit performance with varying output conditions.

4.3.1 REFERENCE SUPPLY

TABLE 4-1 REFERENCE SUPPLY	
Measured Across Component	DC Voltage Reading ±10%
R31	15*
CR11	24
CR10	5.1
CR66	6.5
CR9	9.3

* If this voltage is in tolerance, check the line regulation (±10% from nominal line) and noise level across R31. A line regulation of 10 mv or less and a noise level of 1 mv or less indicates the reference supply is operating satisfactory, and additional voltage checks in this circuit are not required.

TABLE 4-2 PRIMARY VOLTAGES		
Measured Across Component	DC Voltage Reading ±10%	If Out Of Tolerance Refer to Theory of Operation.
C6	32	Positive Aux. Sup.
C22	32	Positive Aux. Sup.

TABLE 4-3 VOLTAGE COMPARATOR VOLTAGES		
Measured from "S" to;	DC Voltage Reading ±10%	NOTE
Base of Q2	7.5	If out of Tolerance refer to Theory of Operation.
Base of Q1	7.5	
Collector of Q1	9.0	

SECTION 5

CALIBRATION

5.1 GENERAL

The following adjustments should be made when necessary to assure optimum operating characteristics and maximum efficiency of the series power supplies.

5.2 TEST EQUIPMENT REQUIRED (or equivalent)

1) Differential VTVM, Fluke Model 825A
2) AC VTVM, Hewlett Packard Model 400D
3) Oscilloscope, Tektronix Model 561
4) Variable Auto transformer, 3 phase type with 20 amp minimum rating
5) Standard Ammeter-Full scale at least 120% of rated supply current

Shorting Link Application

For test purposes shorting links should be connected across rear panel barrier strip terminals 3 and 4, 6 and 7, 8 and 9 and 11 and 12 to provide local sensing and local voltage programming operation. To reduce pickup, shielded wire must be used for all connections between test equipment and the power supply being tested. To prevent ground connection be made, as shown in Fig. 5-1. Tighten all terminals as securely as possible and set all front panel controls CW.

5.3 CALIBRATION PROCEDURE

Current Limit

1) Set the front panel current adjustment control R60 to its maximum setting (fully CW).
2) Set the front panel voltage adjustment controls to provide rated output voltage.
3) Apply an external load to the output terminals and adjust the load resistance for a maximum current of 120% of the rated current. It may be necessary to adjust R48, the internal current adjustment pot, to reach the specified current.
4) Using a standard ammeter in series with the external load, adjust R48 to obtain a current reading of 1.05 to 1.15 rated current as observed on the standard meter.

Ammeter Adjustment

1) Using a standard ammeter in series with an external load, adjust the output voltage and load resistance to provide exactly rated current as observed on the standard ammeter.

Constant Voltage Operation

Load Regulation

With the equipment connected as shown in Fig. 5-1, connect a suitable load resistance across the output terminal connections. The load resistance selected must be able to dissipate the rated power of the unit (P=IE) and must be of sufficient value to yield the rated output current when the rated voltage is applied. Note the voltage indicated on the Differential VTVM. Disconnect the resistive load from the output. If the change in output DC voltage is more than .1% + 5 mv of the output voltage, adjust the Voltage Regulator Adjustment R13 to meet or improve the regulation specification. This adjustment should be made while alternately switching the load on and off.

Line and Load Regulation

Using the equipment as shown Fig. 5-1, place the same load resistance as previously used for load Regulation Measurement across the output terminals, and note the Differential VTVM indication. Vary the AC input voltage 10% above and below the nominal AC input level and record the maximum and minimum output voltages. Remove the load resistance and, again, vary the AC input voltage 10% above and below the nominal AC level and record the minimum and maximum output voltages. The calculated combined line and load regulation should be less than the specification, 0.2% + 10 mv. If this regulation can not be met, repeat the procedure for adjustment of load regulation.

Ripple Voltage

In order to reduce pickup, shielded test leads should be used in making ripple measurements. With the resistive load connected across the output terminals, measure the AC ripple with the AC VTVM. Vary the AC input power 10% above and below the nominal AC input level. The maximum ripple amplitude should not exceed the value specified on the data sheet for the model under test.

Constant Current Operation

Load Regulation

With the equipment connected as shown in Fig. i -, and with nominal AC input voltage, adjust the output voltage to its rated value. Apply a resistive load to the output terminals and adjust both the load resistance and the front panel current adjustment pot until the power supply is delivering rated power into the load and is operating in the constant current mode, as indicated by illumination of the mode indicator lamp.

Record the reading on the differential VTVM and close the shorting deivce (see Fig. 5-2). Adjust the current regulator adjustment R39, while alternately shorting out the load resistance, to obtain the best possible load regulation.

Line and Load Regulation

With the equipment connected as shown in Fig. 5-2, and with nominal AC input, adjust the power supply to deliver rated power into the load while operating in the constant current mode. Vary the AC input voltage 10% above and below the nominal AC input and record the maximum and minimum output voltages. Close the shorting device and repeat the voltage measurements as the line voltage is, again, varied 10% above and below the nominal AC input level. The calculated combined line and load regulation should be less than 1% I_{rated} or 1 amp, whichever is greater.

Phase Balance Controls

With the equipment connected as shown in Fig. 5-1, and with nominal input voltage, set the output voltage to approximately 1/6 of maximum voltage. Connect a suitable load resistance to the output terminals of the power supply such that rated current will flow. Adjust the Phase Balance Controls, R86, R81, R78, to establish a symmetrical ripple waveform as observed on the oscilloscope.

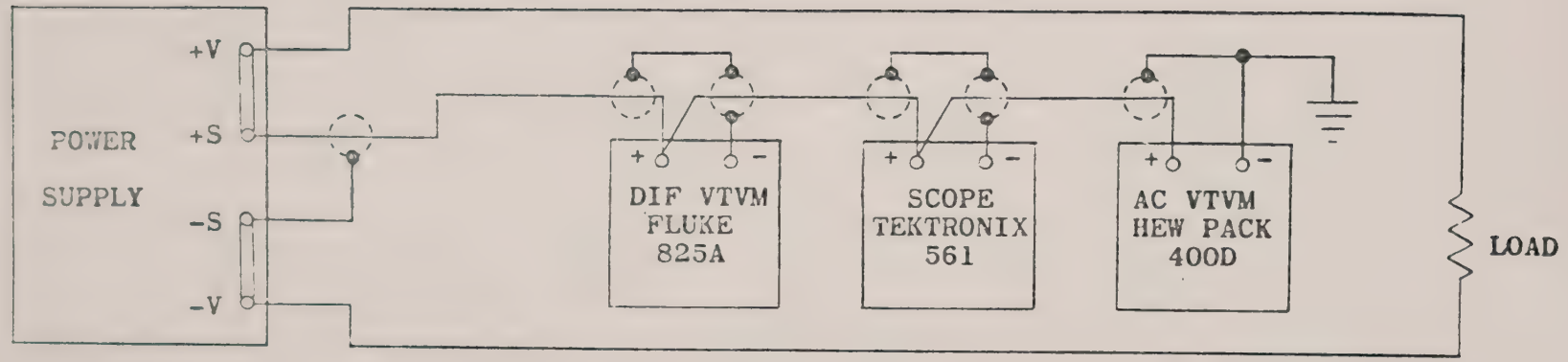


FIGURE 5-1
CONSTANT VOLTAGE OPERATION

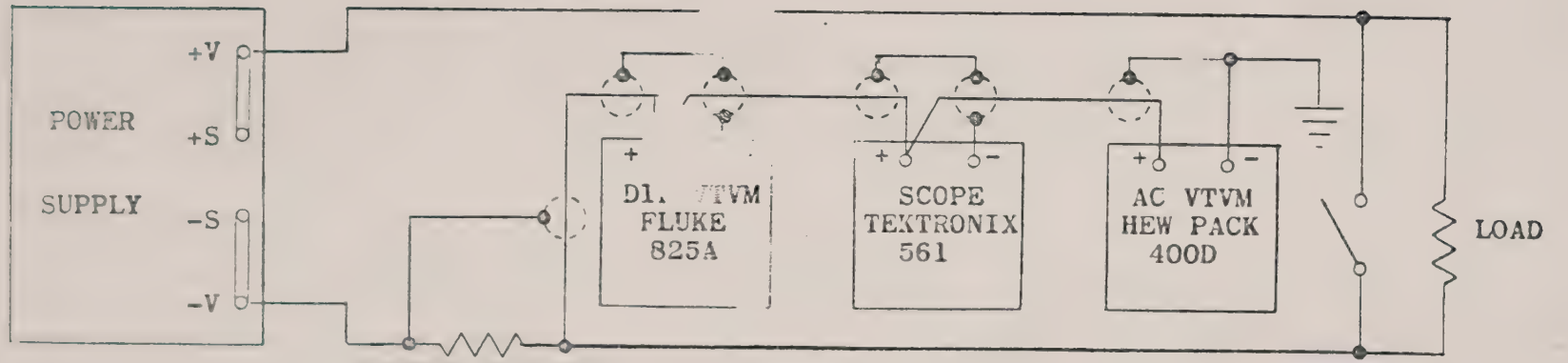
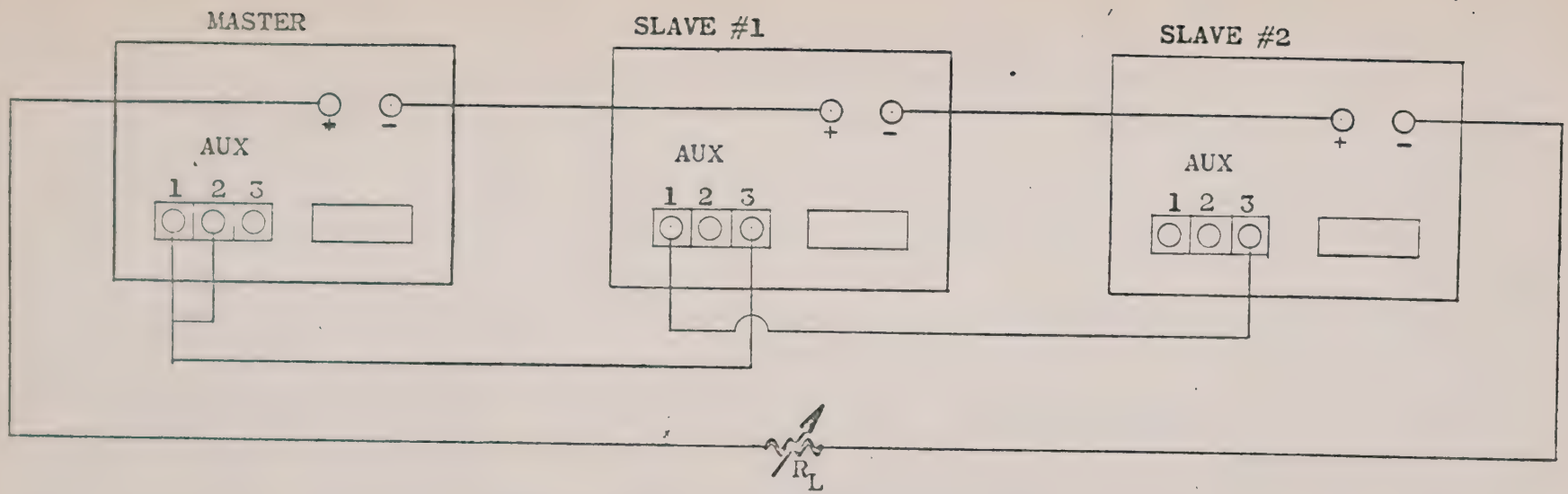


FIGURE 5-2
CONSTANT CURRENT OPERATION

TRYGON
ELECTRONICS INC.



HOOK UP FOR AUTO SERIES OPERATION

ADJUSTMENT:

1. Remove jumper from Aux Barrier terminals 1 & 2 on unit(s) designated as slaves(s).
2. Connect Aux terminal 1 on Master to terminal 3 on Slave #1.
3. Connect AUX terminal 1 on Slave #1 to AUX terminal 3 of Slave #2. Additional Slave units may be added in a similar manner.
4. Connect heavy load leads from negative Master to positive Slave #1 and so on, as shown.
5. Rotate current adjust controls fully clockwise.
6. Adjust voltage adjust on all supplies for approximately their mid position. Apply power to all supplies, if possible simultaneously.
7. Adjust Slave #1 voltage control to match voltage on master. Adjust Slave #1 and Master. At this point no further adjustment need be made on Slaves(s). Master voltage control and master current adjust will control output voltage and current respectively.

MANUFACTURER'S CODE LISTING - ELECTRICAL PARTS

1) The numbers designated in the SPARES column of the following ELECTRICAL PARTS LISTING indicate the recommended spare parts requirement for support of this equipment for a period of one year.
2) The code designations listed in the MFR column of the ELECTRICAL PARTS LISTING have been assigned to the following manufacturers:

CODE	MANUFACTURER	CODE	MANUFACTURER
A-B	ALLEN BRADLEY	I.E	INDUSTRIAL ELECTRONICS
AMMON	AMMON INSTRUMENTS INC.	MILW	MILWAUKEE
BUSS	BUSS	MOTO	MOTOROLA
CARL	CARLING	MALLI	MALLORY
CD	CORNELL DUBILIER	RCA	RADIO CORPORATION OF AMERICA
CLAR	CLAROSTAT	ROT	ROTRON
CORN	CORNISH	SAGE	SAGE
CTS	CHICAGO TELEPHONE SUPPLY	SANG	SANGAMO
ERIE	ERIE	SPRA	SPRAGUE
GE	GENERAL ELECTRIC	STEV	STEVENS
GI	GENERAL INSTRUMENTS	TRAN	TRANSITRON
HONEY	HONEYWELL	TRY	TRYGON
IREC	INTERNATIONAL RECTIFIER CORP.	UNI	UNITRODE
IRES	INTERNATIONAL RESISTOR CORP.	WILG	WILGREEN
OHM	OHMITE	WL	WARD LEONARD
SCHW	SCHWEBER	SEMC	SEMCOR
IND. DEV.	INDUSTRIAL DEVICES	HOFF	HOFFMAN

LIST OF ELECTRICAL PARTS - CR36-100

Designation	Component	MFR	Part Number	Spares	STOCK NUMBER
B1,2	Fan Muffin	IMC	WS2107F	1	890020
C1	Capacitor, 75 MFD, 50V	SPRA	34D756H050FJ4	1	810110
C2	Capacitor, 100 MFD, 50V	SPRA	39D107G050EJ4	1	810130
C3,9,10,11	Capacitor, 30 MFD, 50V	SPRA	40D306F050DH4	3	810050
C4	Capacitor, .1 MFD, 200V	SPRA	148P10402	1	800180
C5,6	Capacitor, 500 MFD, 75V	SPRA	39D507G075HL4	2	810223
C7	Capacitor, 250 MFD, 6V	SPRA	40D257F006DH4	1	810170
C8,19,20,21	Capacitor, 10 MFD, 50V	MALL	TT W/XE	3	810010
C12-17	Capacitor, 78000 MFD, 45V	TRY	820461	3	820461
C18	Capacitor, 1 MFD, 250V	COMA	METAL MYLAR	1	800304
C22	Capacitor, 450 MFD, 50V	SPRA	39D	1	810212
C23	Capacitor, .1 MFD, 250V	COMA	METAL MYLAR	1	800185
CB1	Circuit Breaker, 250 VAC, 60 Hz. 30A, 3 Curve	HEIN	3263S	1	760116
CR1-7,14-19 30-65,67	Diode, Zener	GI	1N4384	24	720384
CR8,10,13,27	Diode, Zener	TRAN	1N751A	3	720181
CR9	Diode, Zener	MOTO	Z0132	1	720263
CR11	Diode, Zener	HOFF	1N1360A	1	720241
CR12	Diode, Zener	UNIT	UZ815	1	720150
CR20,21,22	Rectifier, Silicon, Control	GE	C50BX165	2	720040
CR23,24,25,26	Diode	MOTO	MR211SBR	2	725048
CR28	Diode, Zener	UNIT	UZ715	1	720149
CR29,65	Diode, Zener	UNIT	UZ806	1	720151
CR66	Diode, Zener	TRAN	SV515	1	720110
CR68,70	Diode,	TRY	TR4148	1	725077
DS1,2,3	Pilot Light	IND. DEV.	1040A87	3	770020
DS4	Light Ind.	IND. DEV.	2190A87	1	770023

LIST OF ELECTRICAL PARTS - CR36-100

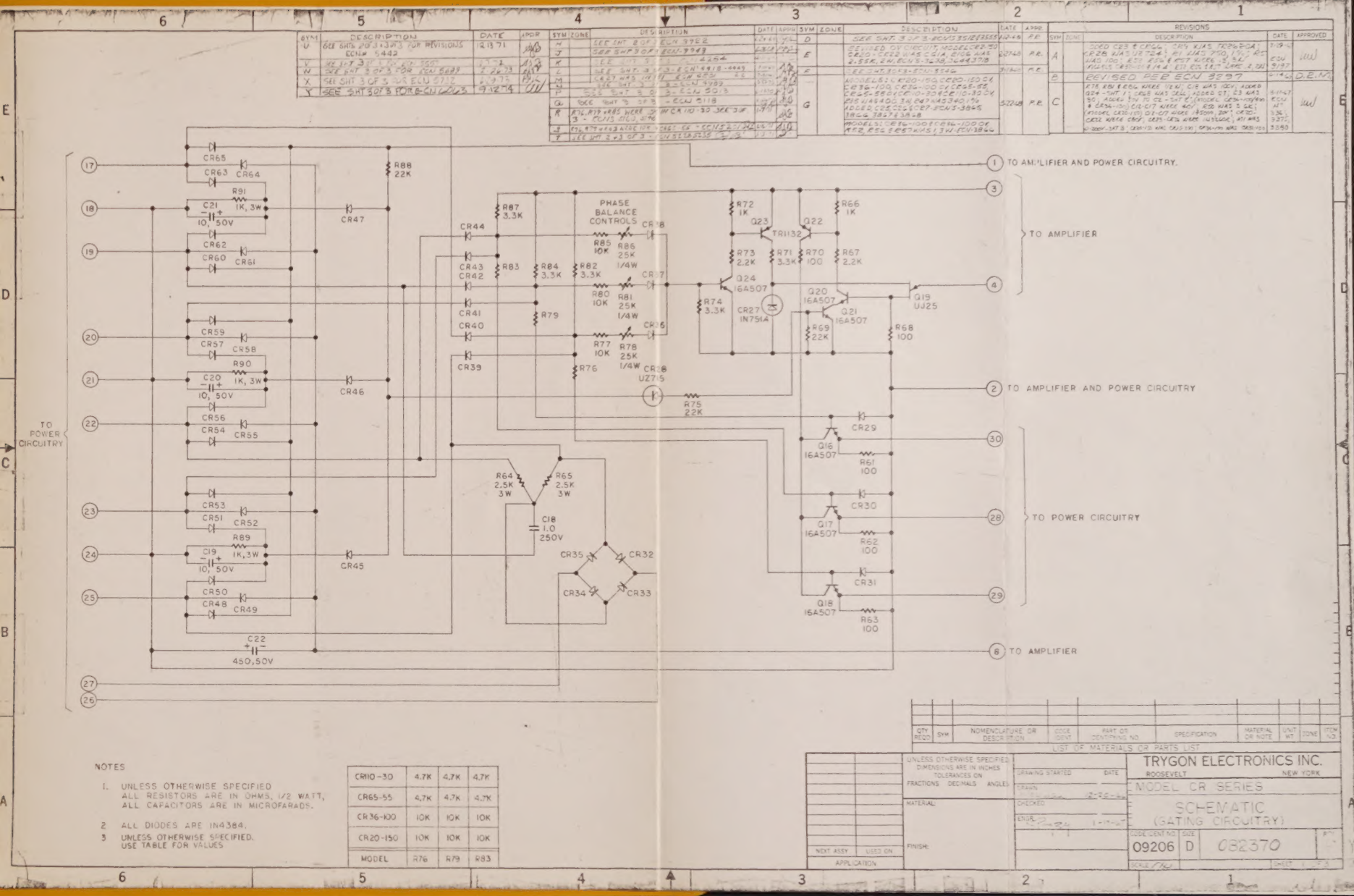
Designation	Component	MFR	Part Number	Spares	STOCK NUMBER
K1	Relay	ALL CON.	TS-154-4C-8.4 MA	1	760275
L1	Choke	TRY	CR32-100	1	506450
M1	Meter, 100A, EXT.	HONEY	MS2T	1	750103
M2	Meter, 40V	HONEY	MS2T	1	752055
Q1-6,10,11, 16-18,20,21,24	Transistor	GE	16A507	7	700180
Q7,8,22,23	Transistor	TRY	TR1132	2	700000
Q9	Transistor	TRY	TR2195	1	700110
Q12-15	Transistor	TRY	TR1490	1	700080
Q19	Unijunction, UJ25	GE	4JX5E600	1	720145
R1	Resistor, 681Ω, .5W, 1%	IRES	TYPE CECTO	1	620220
R2	Resistor, 100Ω, .5W, 1%	IRES	TYPE CECTO	1	620330
R3,43	Resistor, 511Ω, .5W, 1%	IRES	TYPE CECTO	2	620180
R4	Resistor, 249Ω, .5W, 1%	IRES	TYPE CECTO	1	620080
R5,66,72	Resistor, 1KΩ, .5W, 10%	AB	RC20GF102K	3	610180
R6	Resistor, 9.95KΩ, .5W, 1%	IRES	TYPE CECTO	1	620600
R7	Resistor, 390Ω, .5W, 10%	AB	RC20GF391K	1	610130
R8,41,61,62,68 70,63	Resistor, 100Ω, .5W, 10%	AB	RC20GF101K	4	610070
R9,42	Resistor, 199.95KΩ, .5W, .5%	IRES	CECTO	2	620900
R10,36	Resistor, 1KΩ, .5W, 1%	IRES	CECTO	2	620300
R11,14,16,23,24 38,40,46,93	Resistor, 4.99KΩ, .5W, 1%	IRES	CECTO	4	620580
R12,15	Resistor, 6.81KΩ, .5W, 1%	IRES	CECTO	1	620596
R13,39	Potentiometer, 150Ω, 1.5W, 20%	CTS	110	2	600071
R17,18	Resistor, 1.5KΩ, .5W, 1%	IRES	CECTO	1	620360
R19,22	Resistor, 220KΩ, .5W, 10%	AB	RC20GF224K	1	610500
R20	Resistor, 470Ω, .5W, 10%	AB	RC20GF471K	1	610140

LIST OF ELECTRICAL PARTS - CR36-100

Designation	Component	MFR	Part Number	Spares	STOCK NUMBER
R21	Resistor, 604Ω, .5W, 1%	IRES	CECTO	1	620210
R25	Resistor, 100KΩ, .5W, 10%	AB	RC20GF104K	1	610350
R26	Resistor, 200Ω, .5W, 1%	IRES	CECTO	1	620070
R27,48	Potentiometer, 500Ω, 1.5W, 20%	CTS	110	2	600146
R28	Resistor, 1.99KΩ, .5W, 1%	IRES	CECTO	1	620430
R29,31	Resistor, 3.01KΩ, .5W, 1%	IRES	CECTO	1	620480
R30	Resistor, 200Ω, 3W, 3%	SAGE	1300S200-3	1	630270
R32	Resistor, 47KΩ, .5W, 10%	AB	RC20GF473K	1	610340
R33	Resistor, 50Ω, 10W, 5%	WL	10XM50	1	640300
R34	Resistor, 300Ω, 5W, 5%	CLAR	VC5E	1	640420
R35	Resistor, 400Ω, 3W, 3%	SAGE	1300S400-3	1	630320
R37	Resistor, 1.2KΩ, .5W, 10%	AB	RC20GF122K	1	610190
R44,45	Resistor, 150Ω, .5W, 10%	AB	RC20GF151K	1	610080
R47	Resistor, 340Ω, .5W, 1%	IRES	CECTO	1	620130
R49,60	Potentiometer, 100Ω, 2W, 10%	TRY	B6132	2	600059
R50	Potentiometer, 4.5KΩ, 4W 10%	TRY	B4858	1	600279
R51	Meter, Shunt	TRY		1	081888
R52,56,57	Resistor, .3Ω, 5W	TRY		1	600260
R53,54,55	Resistor, 11Ω, 155W	MILW	18-68RX	1	650320
R58	Resistor, 150Ω, 3W, 3%	SAGE	1300S150-3	1	
R59	Resistor, 700Ω, 10W, 5%	IMPAL		1	640494
R64,65	Resistor, 2.5KΩ, 3W, 3%	SAGE	1300S2500-3	1	630450
R67,73	Resistor, 2.2KΩ, .5W, 10%	AB	RC20GF222K	1	610210
R69,75,88	Resistor, 22KΩ, .5W, 10%	AB	RC20GF223K	3	610310
R76,77,79,80,83 85	Resistor, 10KΩ, .5W, 10%	AB	RC20GF103K	3	610290
R78,81,86	Potentiometer, 25KΩ, .25W, 10%	CTS	UPE200R	3	600364
R71,74,82,84,87	Resistor, 3.3KΩ, .5W, 10%	AB	RC20GF332K	3	610230
R89,90,91	Resistor, 1KΩ, 3W, 3%	SAGE	1300S1000-3	1	630390
R92	Potentiometer, 50Ω, 1.5W, 20%	CTS	110	1	600021
T1	Transformer	TRY	505504	1	505504
T2,3,4	Transformer, ST50-2-2	TRY	B1674C	1	501010

LIST OF ELECTRICAL PARTS - CR36-1000V

Designation	Component	MFR	Part Number	Spares	TRYGON STOCK NO.
C100	Capacitor, 25 MFD, 50V	GE	GE62F30S	1	810045
CR100,101,107	Diode	TRY	TR4148	1	720440
CR102	Diode	TRAN	1N751A	1	720181
CR103	Thyristor	MOTO	MAC3-2	1	725140
CR104	Diode	MOTO	MR1220	1	725056
CR105	Rectifier, Silicon, Controlled	GE	C80F	1	725008
Q101	Transistor	TRY	TR496	1	700045
Q102	Transistor	TRY	TR2905	1	700115
L2	Choke	TRY	501380	1	501380
R100	Resistor, 3.01KΩ, .5W, 1%	IRES	TYPE CEC-TO	1	620480
R101	Resistor, 680Ω, 2W, 10%	IRES	TYPE BWH	1	620480
R102	Resistor, 220Ω, .5W, 10%	AB	RC20GF221K	1	610100
R103	Resistor, 3.3KΩ, .5W, 10%	AB	RC20GF332K	1	610230
R104	Potentiometer, 10KΩ,	CTS	TYPE 100	1	600410
R105	Resistor, 1KΩ, .5W, 10%	AB	RC20GF102K	1	610180
R106	Resistor, 1.5KΩ, 3W, 3%	SAGE	1300S1500-3	1	630420
R107	Resistor, 470Ω, .5W, 10%	AB	RC20GF471K	1	610140
R108	Resistor, 2.5KΩ, 10W, 5%	WL	10XM2500	1	640543
R109	Resistor, 33Ω, .5W, 10%	AB	RC20GF330K	1	610020



SYM	DESCRIPTION	DATE	APPR
U	SEE SHTS 2 OF 3 + 3 OF 3 FOR REVISIONS ECN# 5442	12.13.71	
V	SEE SHT 3 OF 3 FOR ECN 5689	4-7-73	
W	SEE SHT 3 OF 3 FOR ECN 5689	4-26-73	
X	SEE SHT 3 OF 3 FOR ECN 5772	9-12-74	
Y	SEE SHT 3 OF 3 FOR ECN 6003		

SYM	ZONE	DESCRIPTION	DATE	APPR
H		SEE SHT 2 OF 3 ECN 3762		
J		SEE SHT 3 OF 3 ECN 3943		
K		SEE SHT 3 OF 3 ECN 4254		
L		SEE SHT. 3 OF 3 ECN 4918-4949		
M		C67 WAS 100 pf ECN 4251		
N		SEE SHT. 3 OF 3 ECN 4989		
P		SEE SHT. 3 OF 3 ECN 5013		
Q		SEE SHT. 3 OF 3 ECN 5118		
R		R76, R79 + R83 WERE 3K IN CA110-130 SEE 3 OF 3 3 - ROWS ABOVE, SAME		
S		R76, R79 + R83 WERE 10K SEE CA110-130 SEE 3 OF 3 ECN 5211		
T		SEE SHT 2 OF 3 + SHT 3 OF 3 ECN 5442		

SYM	ZONE	DESCRIPTION	DATE	APPR
D		SEE SHT. 3 OF 3 ECN 3762		
E		REVISED TO CIRCUIT, MODELS CR2-50 CR2-100 WAS CC2A, CR6 WAS 2.55K, 2W, ECN 5-3238, 5-4437B	2-27-69	P.R.
F		SEE ECN 3049 - ECN 3946	3-14-69	P.R.
G		MODELS CR1-150 CCR2-150 CA CR36-100 CR36-100 CA CR25-55 CR25-55 CA CR10-30 CC10-30 CA PRE WAS 4.7K, 1/4W, 5% 4.7K 1/2W 10% MODELS CR2 CC2 CA CR2 CA 3845 3846 3847 3848	5-22-69	P.R.
		MODELS CR36-100 CR20-150 CR36-100 CA MFR. REQ. SEE TWKS. 1, 3 W. ECN 3844		

SYM	ZONE	REVISIONS	DATE	APPROVED
A		ADED CR3 & CR46; CR49 WAS, TO 2-70A; CR28 WAS 12 TO 24; R1 WAS 2700, 1W; R2 WAS 100, 1/2 W; R7 WAS 2.2K; R8 WAS 1K; CR4 WAS 1N645 PER ECN 3844	7-19-71 ECN 6/97	
B		REVISED PER ECN 3897	9-14-71	D.E.N.C.
C		R78, R80 & R86 WERE 10K; C18 WAS 1.0CH; ADDED Q24 - SHT 1; CR28 WAS 24V, ADDED CT; Z3 WAS 30; ADDED TP1 TO TP - SHT 2; MODEL CR36-100 WAS 4 CR36-100A; C15-C17 WERE 40V; R32 WAS 2.5K; MODEL CR20-150 Q1-Q17 WERE 150mA, 20V; CR7 TO CR32 WERE CR6Z; CR33-CR34 WERE 1N5624; A11 WAS 2-200K - SHT 3; CR30-32 WAS CR35-37; CR34-36 WAS CR38-40	11-17-71 ECN AT 3-24-72 3575 3580	

NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/2 WATT, ALL CAPACITORS ARE IN MICROFARADS.
2. ALL DIODES ARE IN4384.
3. UNLESS OTHERWISE SPECIFIED, USE TABLE FOR VALUES

CR110-30	4.7K	4.7K	4.7K
CR65-55	4.7K	4.7K	4.7K
CR36-100	10K	10K	10K
CR20-150	10K	10K	10K
MODEL	R76	R79	R83

QTY REQD	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	PART OR IDENTIFYING NO.	SPECIFICATION	MATERIAL OR NOTE	UNIT WT	ZONE	ITEM NO.

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES

MATERIAL

FINISH

NEXT ASSY USED ON

APPLICATION

DRAWING STARTED DATE

DRAWN

CHECKED

ENGR

TRYGON ELECTRONICS INC.
ROOSEVELT NEW YORK

MODEL CR SERIES

SCHEMATIC
(GATING CIRCUITRY)

CODE IDENT NO. 09206 | SIZE D | 082370 | REV

SCALE NONE | SHEET 1 OF 1

MP MASTER
MA34127